SUMMARY OF RESEARCH - FY84

RESEARCH PROGRAM

DIVISION OF PLANNING

NORTHERN REGION

ALASKA DEPARTMENT OF TRANSPORTATION

AND PUBLIC FACILITIES

2301 Peger Road
Fairbanks, Alaska 99701-6394

June 1984

Richard Knapp	Commissioner
Warren Sparks	Deputy Commissioner Headquarters
H. Glenzer, Jr.	Deputy Commissioner Northern Region
Mim Dixon	Director, Division of Planning Northern Region
Larry R. Sweet	Research Manager, Division of Planning Northern Region

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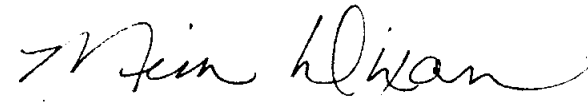
FOREWORD

Developing and testing new technologies can make the State's infrastructure more durable and less costly. Thus, the Research Program of the Department of Transportation and Public Facilities (DOT&PF) has stimulated innovation in the Department and more broadly within Alaska's construction industry.

Challenges of the Research Program are not limited to the realm of engineering and science. We also face the challenge of managing a vigorous research program within the necessary constraints of manpower and budgets. In the past year, management goals for the Research Program have been two-fold: (1) to provide greater focus on program objectives, and (2) to implement research results into Department practices and policies. Progress toward these management goals is reflected in this annual report.

In FY84, the Research Program was a unit within the Division of Planning in the Northern Region of DOT&PF. While the Research Program remains in the Division of Planning, the statewide responsibilities of the Research Program are being given renewed emphasis in FY85 by locating the program administratively within DOT&PF Headquarters. Physically, the Research Program will remain on the University of Alaska, Fairbanks Campus, where we have enjoyed outstanding facilities and excellent working relationships with faculty and students.

Success of the Research Program depends on many people -- the dedicated Research staff, personnel throughout the Department who enthusiastically share their ideas and keep their minds open to new ways of doing things, funding agency representatives who take a personal interest in our work, and the pool of talented and innovative researchers in Alaska who commit themselves to working with us.



Mim Dixon, Director
Division of Planning
Northern Region

In Memory of

BRUCE K. ALDERMAN
1942 - 1984

In 1984 the Research staff was saddened by the loss of Bruce Alderman, a valued engineering technician who had served in that capacity since 1966. Bruce was instrumental in developing and carrying out the statewide road condition and strength inventories made annually by the Research Section, and was without equal in the area of state-of-the-art laboratory testing techniques and their development. We dedicate this issue of the Annual Research Report in his memory.

SECTION 1
STATEMENT OF PURPOSE

Goals of the Research Programs of the Department of Transportation and Public Facilities are to reduce costs, improve efficiency and increase the serviceability of state facilities and transportation systems by better understanding materials, methods, and the environments in which they are used.

The objectives of research are to develop new technical knowledge and implement that knowledge into common use within the Department.

The Research Program is engaged in a broad spectrum of investigations that include highways, buildings and energy related problems, transportation systems research, airport and aviation investigations, ports and harbors.

Research is performed by staff engineers, consultants in the private sector, University faculty, and other government agencies.

Funding for research comes mainly from the State of Alaska General Fund and the Federal Highway Administration Highway Planning and Research (HPR) program. Additional funding comes from other federal agencies, such as the Department of Energy and the Federal Aviation Administration.

Priorities for research projects in two general areas -- highways and facilities -- are established by two research Advisory Boards whose members are selected from the Divisions of Design and Construction, Maintenance and Operations, and Planning in each Region of the Department.

SECTION 2
FACILITIES AND EQUIPMENT

Facilities

The Research Program is housed in the Duckering Engineering Building on the University of Alaska campus in Fairbanks. Research occupies approximately 2500 square feet of office space and shares approximately 4000 square feet of laboratory, shop, and storage space under a joint use agreement with the School of Engineering. Shops include carpentry, machine, welding, and staging areas for construction and testing of equipment.

Laboratory and Test Equipment

Research Program's laboratory and testing equipment include high temperature ovens and low temperature chambers for testing materials under broad temperature extremes, and hydraulic testing machines for tension and compression loading of up to 250,000 pounds. One hydraulic test unit is equipped with an environmental chamber capable of testing samples from -40 degrees Fahrenheit to +400 degrees Fahrenheit.

Facilities permit a variety of soil testing. Common tests include consolidation testing, triaxial strength testing, frost heave testing, and gradation and aggregate soundness tests. A jaw crusher is available for preparation of samples.

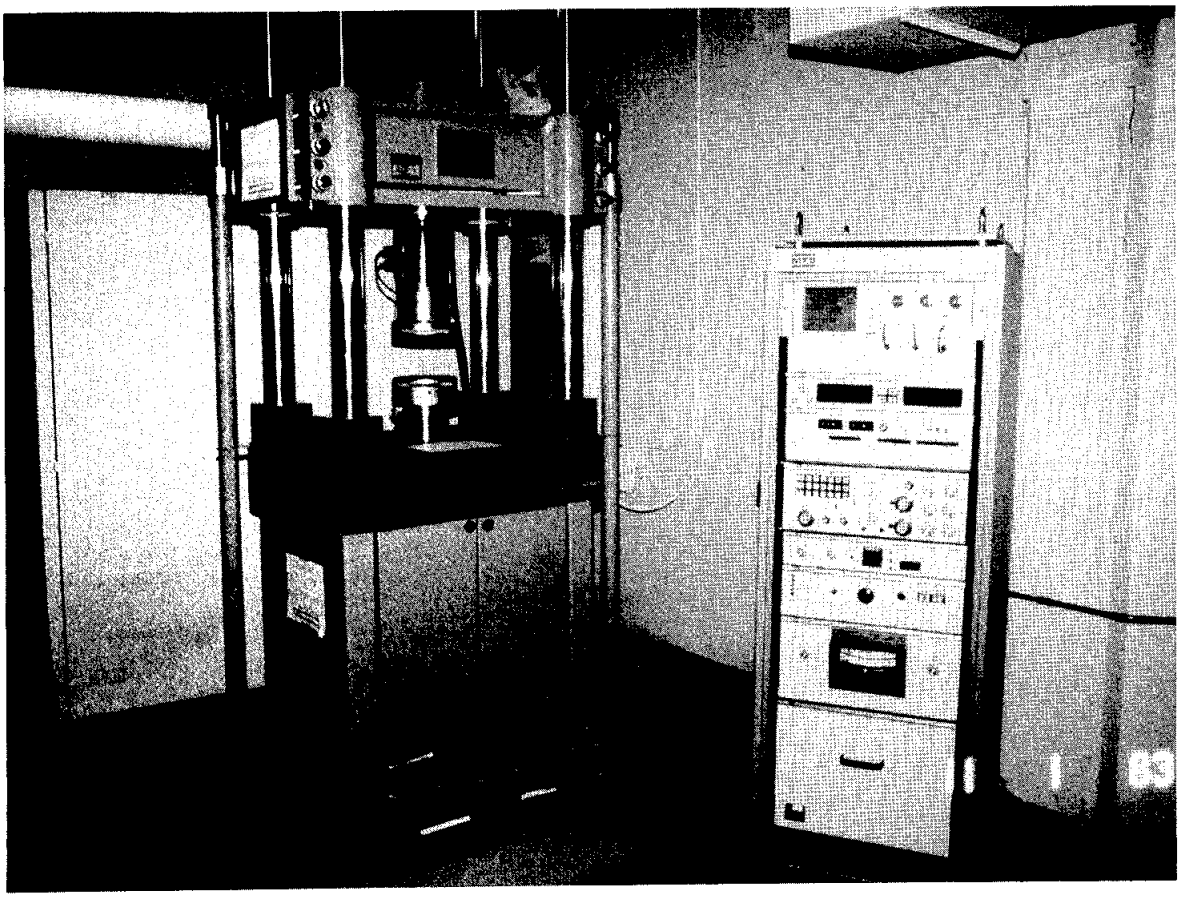
The laboratory is equipped for a full range of standard tests for asphalts, including ductility, penetration, viscosity, abson recovery, and mix designs. In addition, the Research Unit has special equipment for indirect tensile testing and for determining resilient modulus of asphalt concrete.

Limited metalurgical testing can be done, including Rockwell Hardness classification, tensile strength determination, and Charpy impact testing. A muffle furnace is available.

Environmental chambers include two walk-in cold rooms for testing products under controlled conditions. An American Society for Testing Materials (ASTM) guarded "hot box" thermal testing apparatus is used for testing window, door, and wall systems under controlled conditions.

Air infiltration and air quality equipment have the capability of measuring impurities down to 50 parts per trillion.

A Falling Weight Deflectometer (FWD) is available for pavement condition analysis. Also available are rut measuring equipment and a Mays Ride Meter to determine roadway roughness.



The hydraulic load frame shown above is used jointly by the University of Alaska Engineering Department and the Department of Transportation and Public Facilities.

SECTION 3
STAFF

Bruce K. Alderman	Engineering Aide
Dianna Blair	Accounting Technician
Al B. Brawner	Research Engineer
Richard W. Briggs	Electronics Technician
Ethel M. Chandler	Clerk Typist
Billy G. Connor, P.E.	Senior Research Engineer
David C. Esch, P.E.	Highway Research Manager
Lorena A. Hegdal	Research Engineer
Stephen A. Kailing, P.E.	Senior Research Engineer
Leroy E. Leonard	Facilities Research Manager
Robert L. McHattie, P.E.	Senior Research Engineer
Ronald E. Miller, P.E.	Research Implementation Engineer
Firmin S. Murakami	Drafter
Carol L. Pederson	Materials Lab Technician
Matthew K. Reckard	Research Engineer
John F. Rezek, P.E.	Senior Research Engineer
Janet L. Strid	Research Engineer
Larry R. Sweet	Research Manager
Catherine A. Voigt	Clerk Typist

The Research Program borrows engineering staff from other Divisions of the Department during part of the year. These engineers bring to the Research Program knowledge of practical problems they face in the field in the accomplishment of their everyday tasks. These exchanges of personnel promote communication and help in the implementation of new technology within the Department. During the past year, the following personnel from the Division of Design and Construction worked part time on research projects:

Dennis J. Fox	Resident Highway Engineer
Timothy A. Koth	Engineering Assistant

SECTION 4

RESEARCH PROGRAMS

Highway Research Program

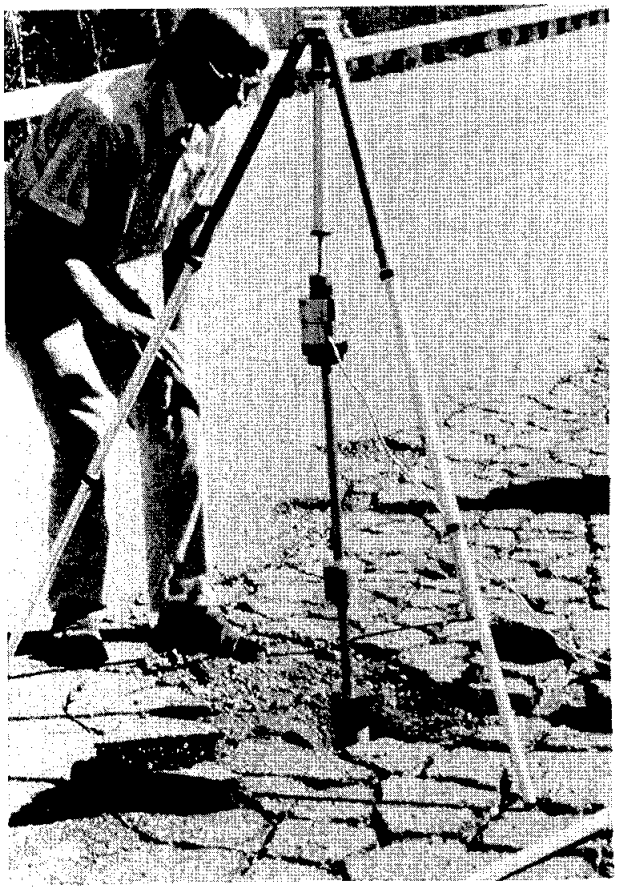
The FY84 Highway Research Program consists of 24 projects funded by Federal Highway Planning and Research (HPR) funds, and 23 projects funded by State appropriations. These projects are grouped into program areas and summarized in order of emphasis and expenditures. Based on current funding levels, these program areas and their percentages of total highway research funds are:

Subject Area	% of Total Funds
Pavement Management	24%
Pavement Structures	17%
Bridges and Culverts	13%
Permafrost Studies	12%
Safety Research	11%
Frost Action and Heave	9%
Thermal Model Studies	6%
All Other Studies	8%
	100%

Pavement Management Studies. This program area comprises 24% of the total Highway Research Program. Major projects include the measurements of roadway strengths on selected routes during the springtime thaw and summer seasons by use of two Falling Weight Deflectometers (FWD), and the selection and field testing of equipment for truck Weighing-in-Motion (WIM). The annual and biennial pavement condition surveys performed by the Research Program now provide historical records of pavement conditions in Alaska since 1978. These data now permit predictions of future life and recommendations for strengthening and reconstruction costs.

In addition to these Research efforts, additional Planning funds have been committed to the development of a formal Pavement Management System for the Department. This system will provide a rational method of analyzing required statewide funding levels, as well as regional and project level funding needs for pavement rehabilitation. With this system in place, it will be possible to determine effects of different funding strategies on the future condition of Alaska's roadway pavements based on historical records, actual roadway strength data, and accurate traffic loading data.

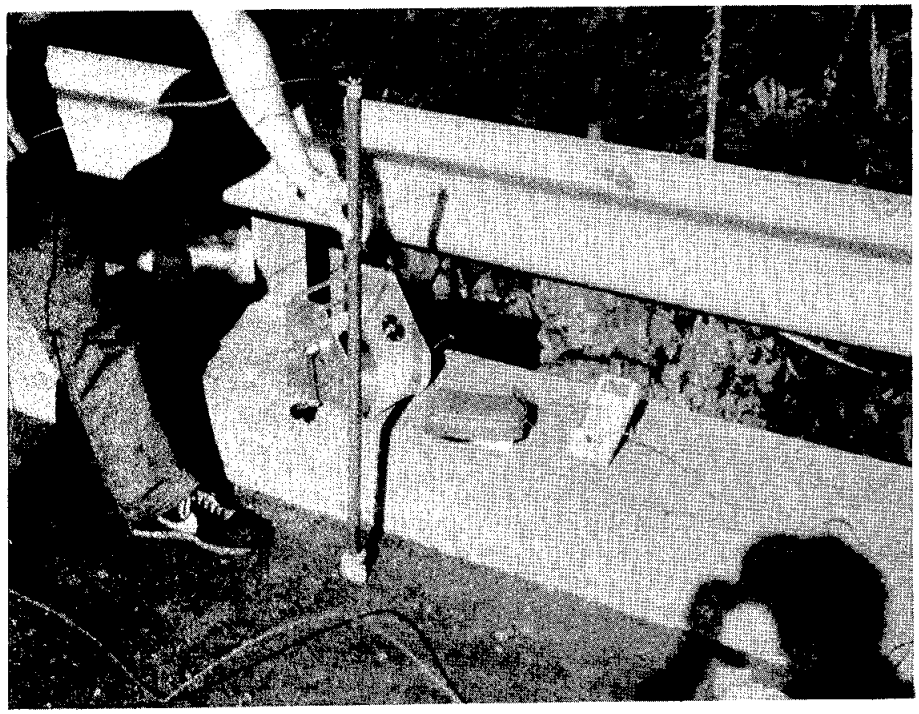
Pavement Structure Research. In 1979 the Highway Research Program completed an intensive study of the relationships between Alaskan pavement performance, materials properties, and environmental and loading factors. Based on 120 different paved roadway sections throughout Alaska, this study culminated in the preparation of a totally new pavement design manual. Since that time, a program of pavement studies has continued with the



Dynamic testing of pavement structure in fatigue failure area with small falling weight test device by Dick Stubstad.

intent of reducing costs, developing new materials, methods, and design procedures, and further clarifying the critical factors in good performance. Currently, eleven pavement studies are underway. Significant progress has been made toward understanding and analyzing the true mechanical performance of various layers affected by wheel loadings. Studies are being conducted to measure the effects of frost action on asphalt-treated and salt-treated base course layers. Thermal contraction and low temperature cracking tendencies of different paving materials are also being studied. The critical problem of low-quality base-course materials is being attacked by a program of laboratory testing. A significant application of pavement research findings is the asphalt emulsion stabilization of 18 miles of low-quality base course stone on the Alaska Highway. Another application has been the on-site cement-emulsion treatment of a native sand to construct a new pavement for the Northway Airport.

Bridge and Culvert Research. Identifying and controlling salt-induced corrosion of bridges and bridge deck reinforcing steel is an important research activity area. Studies have included field surveys to determine



Test equipment used to measure active corrosion levels of reinforcing steel in bridge decks.

the extent of corrosion damage to bridges under various climatic conditions. A new cathodic corrosion protection system on the Wendell Street bridge in Fairbanks is being monitored. The new Gastineau Channel Bridge at Juneau is being monitored to compare actual construction and operational stresses with design assumptions on a unique new type of bridge structure.

A major emphasis of the Bridge and Culvert Program area is river hydrology and fish passages. The State has spent large sums for construction of bridges dictated solely by hydrologic and biological assumptions regarding the abilities of fish to transit upstream during near-peak flood conditions. Research work is directed at reducing the unknowns in these equations. The goal is to prevent construction of unnecessary bridges when less expensive culvert structures can be used.

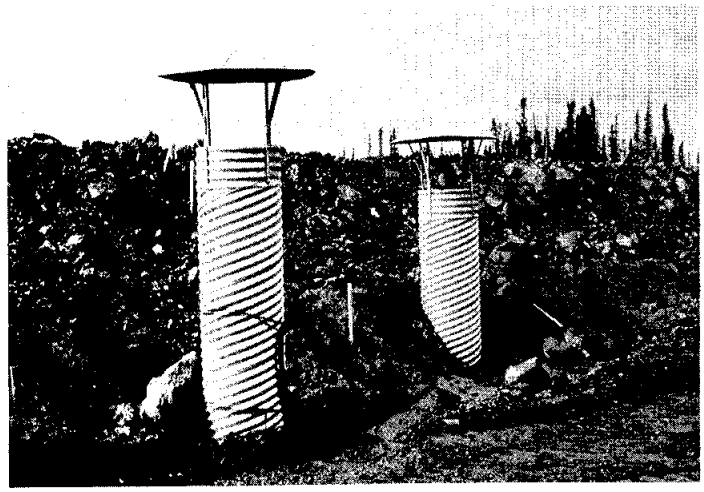
Permafrost Studies. Permafrost Research is probably the oldest type of Highway research performed in Alaska. Field studies commenced in 1953 with the drilling and temperature monitoring of five roadway sites in the Glenallen area. The first plastic foam insulated roadway on permafrost was constructed near Chitina in 1969, and monthly monitoring has continued uninterrupted at that site for 15 years. Five additional experimental roadway sites have been instrumented and included in the long-term monitoring program. All sites are in "warm" permafrost areas, with ground temperatures above 28°F. Warming effects of the roadway and the side slopes cause continuous roadway deformations and changes in the permafrost table which are being noted at all sites. This demonstrates the need for a long-term continuing monitoring program to measure the ultimate consequences of any experimental roadway feature.

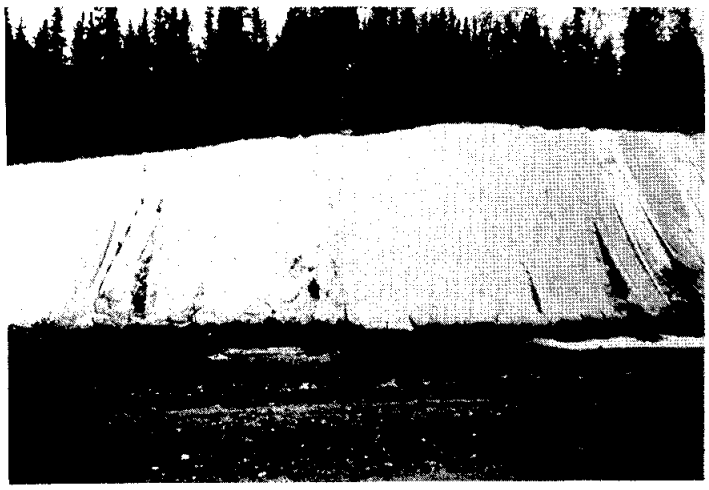
Annual measurements of slope movements on experimental embankment over permafrost.

Subsurface ice deposit formed in active ice-blister field along the Dalton Highway.

Scientific warnings about global climatic warming through the carbon-dioxide related "greenhouse effect" have created particular concerns regarding the long-term stability of all structures founded on warm permafrost. Studies have just been completed on methods of thawing

permafrost in advance of construction. Other methods for lowering roadway surface and side-slope temperatures are being studied. Methods under evaluation include white paint, heat-siphons, air cooling ducts, snow and solar shields, and snow management.



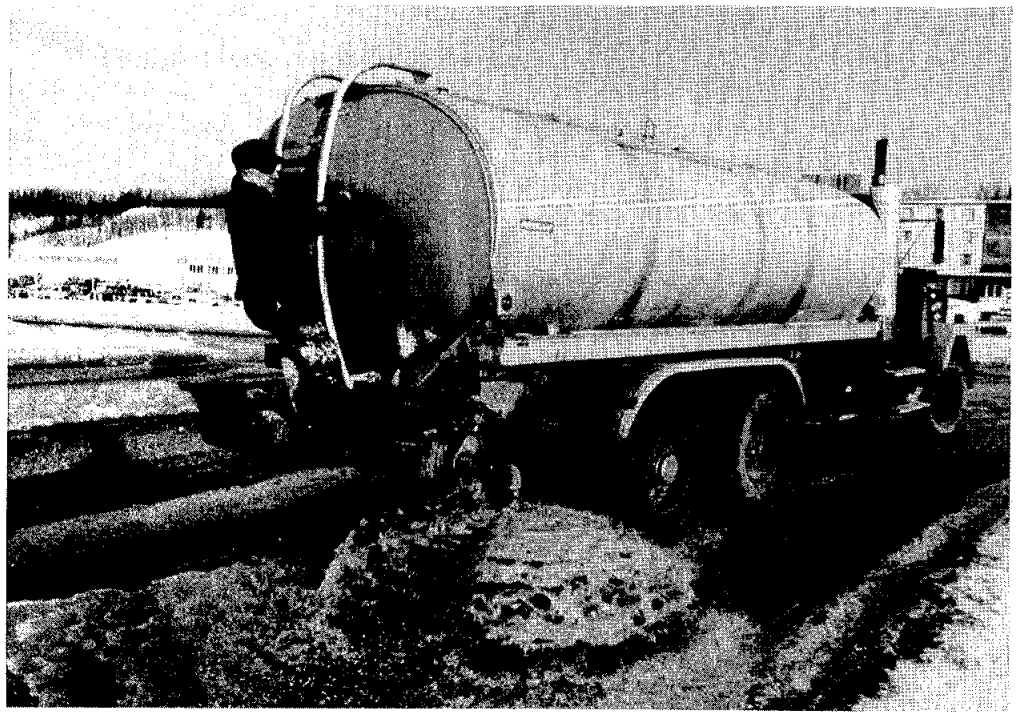


Exhaust stacks of experimental air ducts installed to cool embankment slopes on Alaska Highway near Northway (top left). Slope coverings of urea foam and excelsior mat applied to ice-rich permafrost cut section on Dalton Highway (bottom left). Installation of fabrics to reinforce a test road constructed over buried ice deposits (right).

Engineering fabrics, or geotextiles, are a major new area of interest. Millions of dollars are being spent on Alaska's highways to reinforce embankments over permafrost against cracking and distortions . A unique new study which commenced in April of 1984 is examining the theory and the practical consequences of installing fabrics beneath embankments constructed over pseudo ice wedges of various widths. This study will determine by actual measurements in a known situation the ability of fabrics and embankments to bridge voids created by subsurface ice deposits melting.

Highway Safety Research. Improved methods for snow and ice control to increase wintertime traction and safety is the major emphasis of this program area. Heated roadway sands and asphalt pavements with intermixed rubber granules have demonstrated improvements over present technology. Efforts are underway to further develop these areas. Studies of calcium-magnesium acetates (CMA) as deicing agents in lieu of normal calcium and sodium chlorides are also underway. The economic advantages of decreased vehicle and structure corrosion are expected to offset higher initial costs of acetate salts. A full field trial in one maintenance section is planned for the winter of 1985-86.

Production of calcium-magnesium acetate (CMA) solutions for field testing as a replacement for road salts.



Test application of CMA on icy roadway near Fairbanks.

Frost Heave Studies. Problems predicting and designing for frost heave of soils and their subsequent weakening after thaw have long baffled engineers and forced them to avoid freezing conditions in foundations wherever possible. New theoretical approaches and laboratory tests are being developed to provide a better understanding of this phenomenon. The related problem of predicting the frost heave of buried chilled-gas pipelines has resulted in expenditures by industry estimated at 12 million dollars in the past 5 years.

A major part of this program involves testing and evaluating a frost heave and thaw weakening prediction model recently developed by the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) for the Federal Highway Administration (FHWA). Test sites at Anchorage and Fairbanks are being used in this evaluation. Another major project is the installation

and computer monitoring of two strain-guaged frost heave test piles. These piles are providing continuous data on frost jacking forces on piling. This research should provide a significant contribution to engineering theory.

Thermal Model Studies. To predict permafrost thawing or frost heaving, a good thermal model is required. This project is evaluating existing thermal models for their applicability to Alaskan highway design problems.

Other Studies. Research efforts grouped under this heading include geophysical detection and remote sensing for permafrost, ground ice, or subsurface rock and gravel deposits. Also included are studies aimed at reducing maintenance costs. Another important research activity is monitoring and reporting experimental construction features, such as reinforced earth walls, new types of subdrains, asphalt modifiers, and solar powered railroad crossing signals. The costs of such features are paid from FHWA construction project funds, but long-term monitoring becomes the responsibility of the Research Program. A total of 11 features are being evaluated.

Experimental rubberized sealants applied into routed thermal cracks on Richardson Highway.

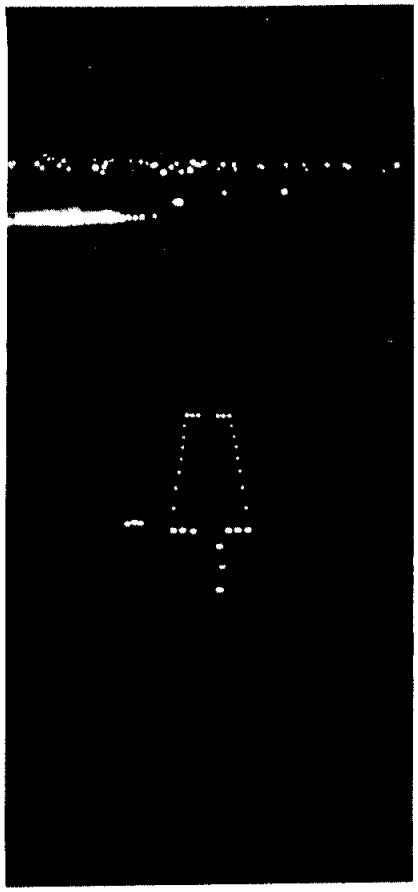
Facilities Research Program

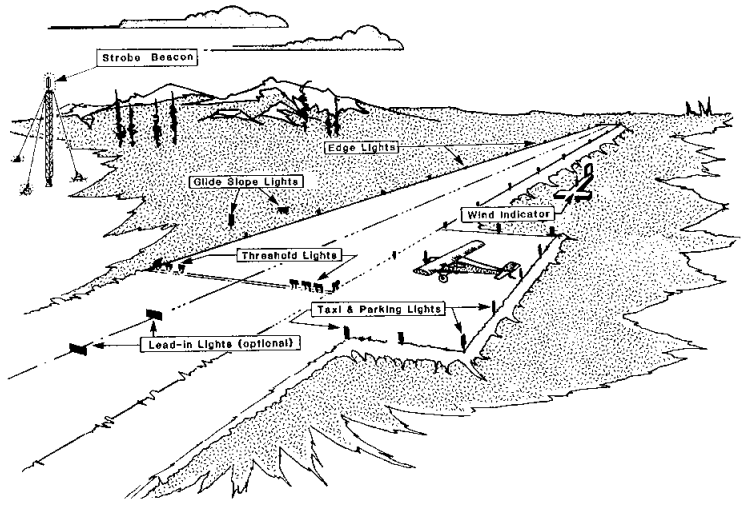
During FY84 the Facilities Research Program was created by combining the existing Energy and Buildings Research Program and the Transportation Systems Research Program. The result is a diverse program of projects which include most of the Department's non-highway research functions. At the close of FY84, there were 45 projects managed by the Facilities Research Program.

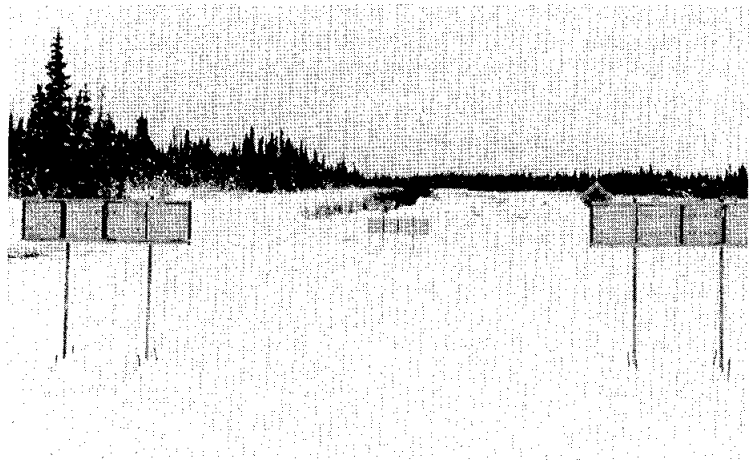
Program areas and their percentages of total Facilities Research Program funding are:

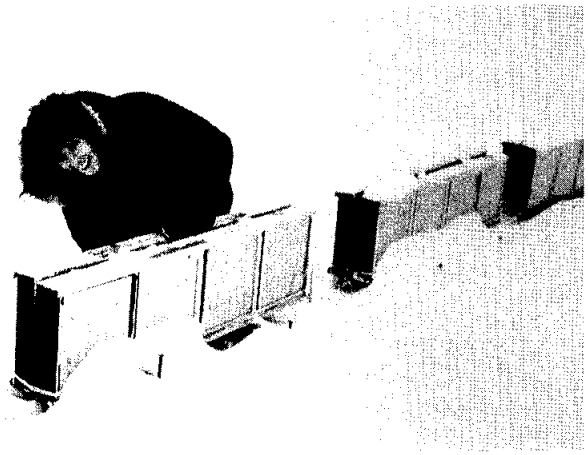
Subject Area	% of Total Funds
Aviation Support Systems	14%
Building Science	21%
Environmental Engineering and Pollution Control	19%
Marine Support Systems	26%
Energy Systems	15%
Communications	5%
	100%

Aviation Support Systems. The Department owns and operates nearly 200 airports statewide. Many of these are small and remote from population centers. A joint research project with the Federal Aviation Administration (FAA) is evaluating an Automatic Weather Observing System (AWOS) which would aid pilots and hopefully improve air safety statewide. A major effort is underway to develop low-cost, reliable runway lighting for small rural airports (see photos on next page). A joint project with the U.S. Department of Energy has resulted in a very promising system which was successfully demonstrated this past winter at the State-owned airport in Central, Alaska. These are called "Radioluminescent" or "RL" lights. Several other projects deal with runway pavements, embankment stabilization and other aviation support facilities problems.



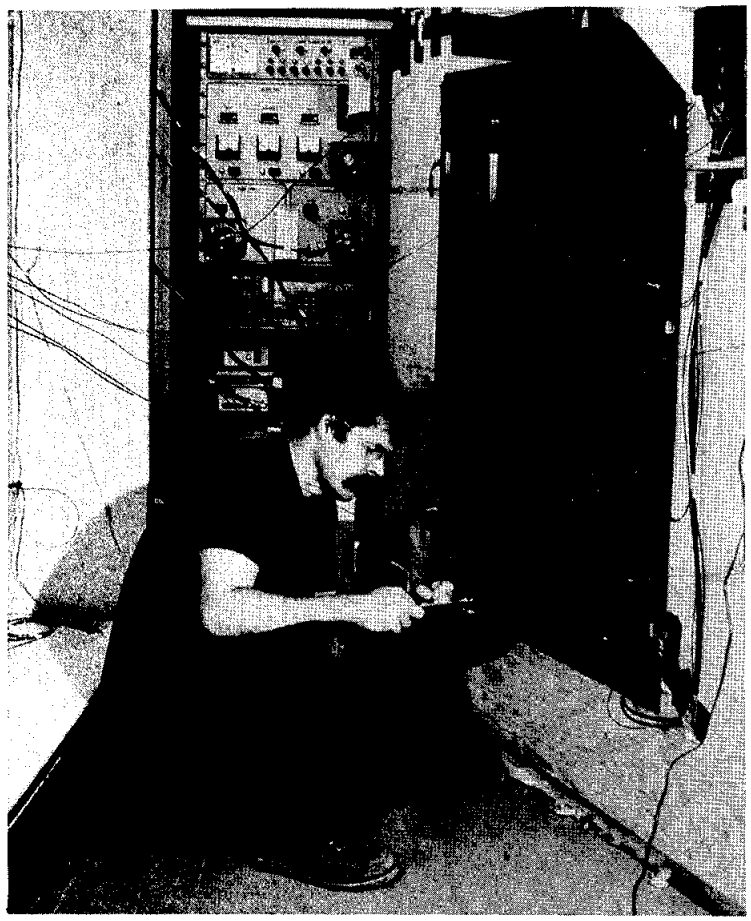






Clockwise from upper left: A radioluminescent lighted airstrip as seen from an approaching aircraft with the lights of DOE Hanford Reservation in the background; an arrangement of panels indicates the correct descent slope for an approaching pilot (vertical altitude slope indicator -- VASI); a wind direction finder using radioluminescent tubes; removing snow from panels.

Building Science. The State of Alaska is responsible for more than 2000 buildings statewide with a gross area in excess of 17,000,000 sq. ft. A survey of building failures is helping the Division of Standards and Technical Services develop specifications to assure that new buildings will be better constructed and easier to maintain.



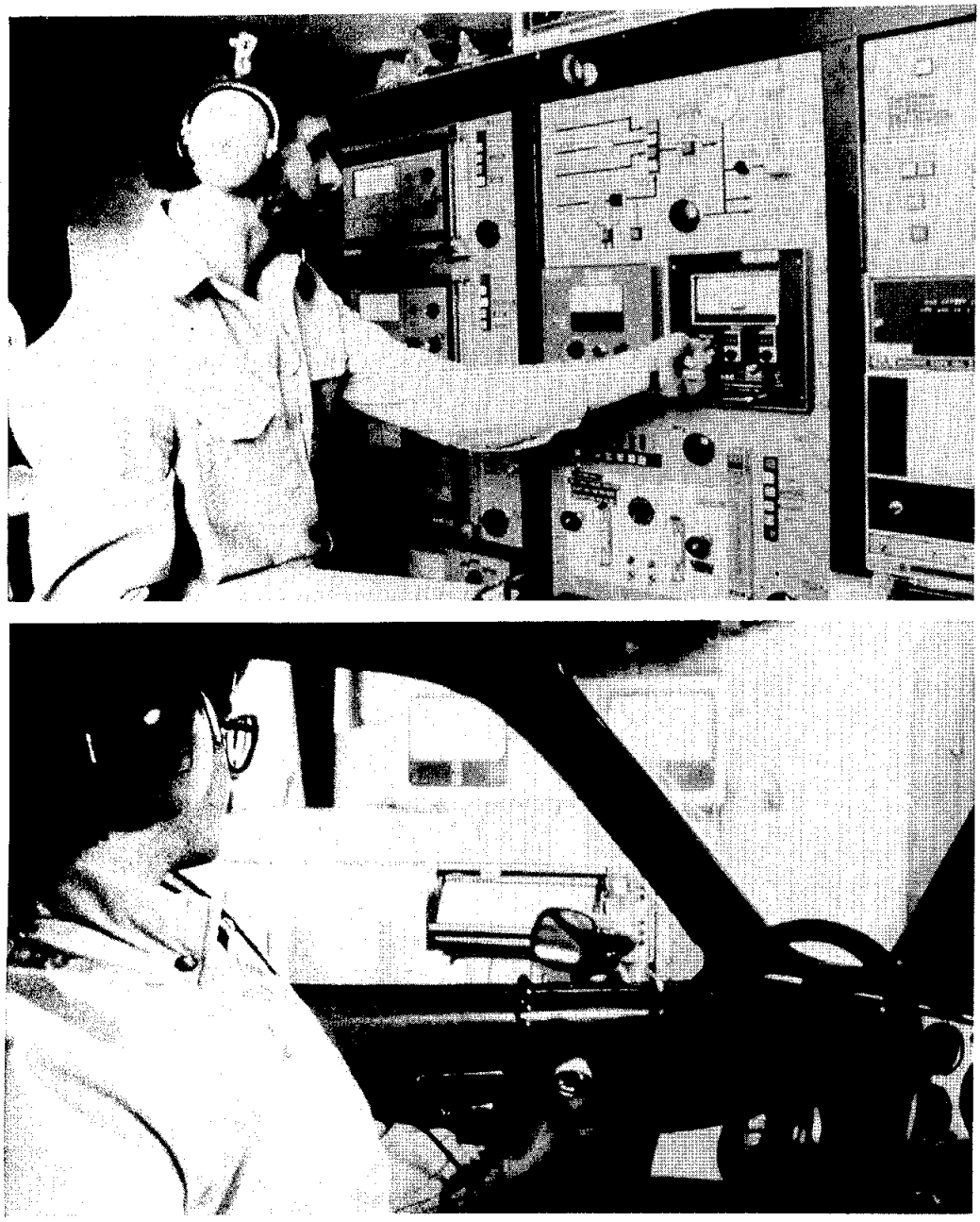
Building Materials Testing: University of Alaska student Ralph Stevenson tests a window system in the Guarded Hot Box. This facility is used to measure the thermal conductivity of building materials.

In 1980 the Legislature directed the Department to develop a set of thermal and lighting standards appropriate to Alaskan conditions. During FY84 a research project for buildings under 12,000 sq. ft. was completed and is

now being incorporated into the Design Standards Manual for Buildings. Work on a standard for larger buildings is underway. Several other projects seek solutions to design and construction problems encountered in the Alaskan environment.

Environmental Engineering and Pollution Control. With the development of transportation systems and public facilities to serve the needs of a growing population come the inevitable implications of environmental degradation. Environmental Sections of the Design and Construction Divisions in Anchorage and Fairbanks must anticipate ambient carbon monoxide pollution generated by automobiles. A project to model the dispersion of carbon monoxide within these air sheds is now underway. A model acceptable to state and federal regulatory agencies will prove cost effective to the Department when planning new transportation systems or modifications to existing systems in these urban areas. Additional projects address indoor pollution and toxic materials in State buildings, vehicular pollution in cold climates, and other environmental problems of concern to the Department and the public.

Air Quality Measurements: Technician Carol Pederson injects an air sample into a gas chromatograph to determine the sulfer hexafluoride content during an air exchange rate measurement.



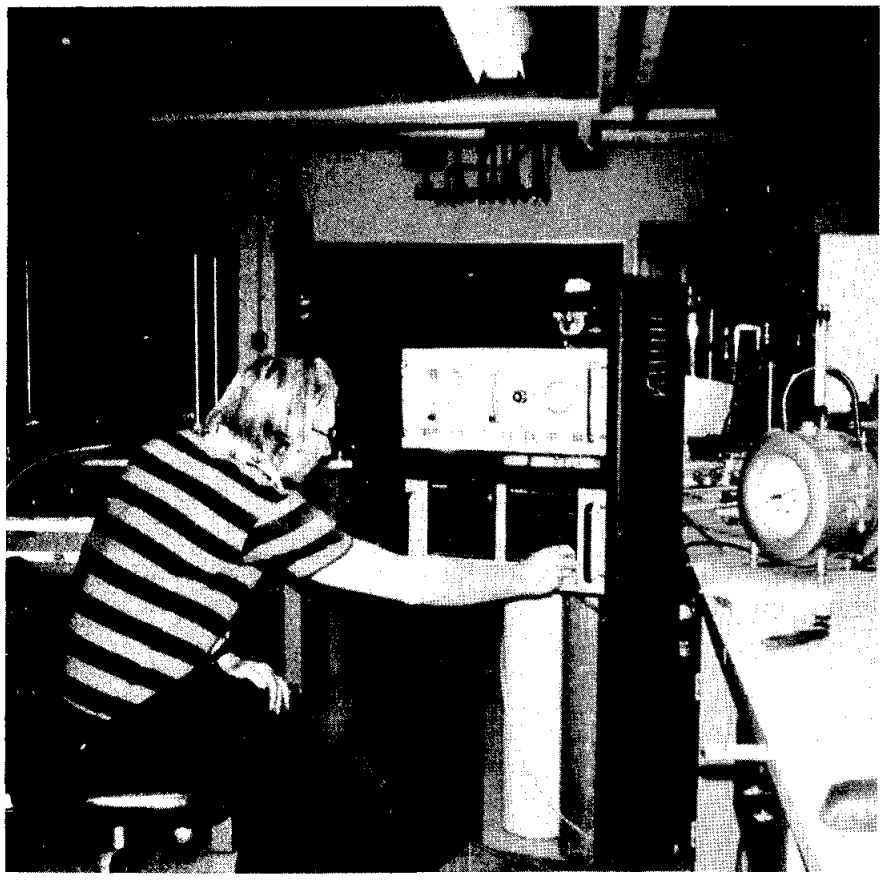
Vehicle Emission Studies: A technician simulates a prescribed driving cycle on a dynamometer (top) while automatic emissions data are measured and recorded (bottom).

Marine Support Systems. Water born transportation is the primary means of exchanging products and commodities between Alaska and the rest of the world. Marine transport and the development of our coastal and inland marine support facilities will have a major impact on the future development of Alaska's economy. For several years the Research Program

has contributed to a joint project with industry and the Federal governments of both Canada and the United States to investigate the potential for Arctic marine transportation. New erosion control methods and corrosion protection of marine structures are other subject areas investigated during FY84. The Research Program managed the first phase of the Jetfoil Demonstration Program which concluded in FY84.

Energy Systems. This research is primarily intended to reduce costs for maintenance and operations. Energy consumed in state facilities and the maintenance and repair of energy systems is a major expense for the Department, as well as many other state agencies. During FY84, Research discovered that these costs may be escalating rapidly in rural Alaska. In the past few years sophisticated electronic and electrical equipment has been installed at locations where the quality of the electric power signal is inadequate. A project is investigating diesel-electric generators, most commonly used in rural Alaska. The goal is to make these generators more efficient while maintaining a high quality of power. Other projects are aimed at energy conservation techniques which the State can implement by better use of insulating materials and construction methods.

Communications. The size of Alaska and the distribution of public facilities require adequate communications. Research projects have been improving state communication systems, most specifically the communications link for Maintenance and Operations personnel. With the transfer of the Division of Telecommunications to the Department of Administration, the responsibility for applied communications research has shifted to that Department. To maintain continuity, the Facilities Research Program managed two ongoing projects in FY84.



Furnace Efficiency: University of Alaska researcher Joe Durrenberger measures flue gas oxygen content while working on a furnace efficiency study.

SECTION 5
SUMMARY OF RESEARCH PROJECTS

HIGHWAY RESEARCH PROGRAM

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
Stabilized Soils Study	State	4 years 9/84	Esch/U.S. Army Cold Regions Research and Engineering Lab
Resilient Soil Properties Study	State	4 years 12/84	McHattie/Oregon State University
Snow and Ice Control Study	State	4 years 9/84	Esch/Petroleum Engineering Department, University of Alaska
Permafrost Culvert Study	State	4 years 12/84	Esch/U.S. Army Cold Regions Research and Engineering Lab
Pavement Thermal Studies	State	3 years 12/83	Esch/U.S. Army Cold Regions Research and Engineering Lab
Pavement Deflection Inventory	State	3 years 6/85	Connor/Woodward-Clyde Consultants
Thermal Properties Measurement	State	3 years 6/85	Esch
Roadway Failure Research	State	3 years 6/85	McHattie/Engineering Experiment Station
Bridge Deck Corrosion	State	2 years 3/84	Reckard
Geophysical Soil Investigation	State	3 years 6/85	McHattie/Johnson
Dalton Highway Performance	State	3 years 6/85	Brawner/Esch/Agricultural Experiment Station/R & M Consult.
Truck Weigh-In-Motion Study	State	3 years 6/85	Connor/University of Alaska Computer Network/Strandberg Cons.
Pile Frost Jacking Study	State	2 years 12/84	Esch/U.S. Army Cold Regions Research and Engineering Lab
CMA Pilot Plant Design and Test	State	3 years 6/85	HcHattie/Petroleum Engineering and Geophysical Institute, UAF
Highway Research Investigation	State	2 years 6/85	Esch/Arctic Environmental Information and Data Center

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
Roadway Strength Inventory	State	4 years 12/85	Connor
Roadway Strength Investigation	State	4 years 12/85	Connor/Engineering Experiment Station
Frost Heave Test Development	State	3 years 6/84	Esch/U.S. Army Cold Regions Research and Engineering Lab
Low Temperature Cracking Studies	State	3 years 12/84	McHattie/Geophysical Institute, University of Alaska
Thermal Analysis Computer Mode	State	3 years 6/84	Connor/Engineering Experiment Station, Geophysical Institute, University of Alaska Computer Network
Highway Performance Evaluation	Federal	1 year 6/84	Connor/Walsh/Engineering Experiment Station
HPR Administration of Research	Federal	1 year 6/84	Esch
Fish Passage/Drainage Structures	Federal	1 year 6/84	Kailing/Institute of Water Resources, UAF
Implementation of Research	Federal	1 year 6/84	Sweet/Kailing/Connor/Institute of Water Resources & Conferences and Institutes, UAF
Gastineau Channel Bridge	Federal	1 year 6/84	Esch/Engineering Experiment Station
Asphalt Surface Treatments	Federal	1 year 6/84	Connor
Hot Winter Sand Benefits	Federal	1 year 6/84	Reckard/Pennsylvania State University
Highway Thaw Settlement Control	Federal	1 year 6/84	Reckard/USKH Consultants
Evaluation of AC 1.75 Asphalt	Federal	1 year 6/84	McHattie
Pavement Life Versus Loadings	Federal	1 year 6/84	McHattie
Gardner Creek Air Ducts	Federal	1 year 6/84	Brawner

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
Optimizing Ingredients for Plus-Ride	Federal	1 year 6/84	Esch/Oregon State University
River Training Structures	Federal	1 year 6/84	Brawner/Institute of Water Resources
Tensile Reinforcements of Road	Federal	1 year 6/84	McHattie
Permafrost Temperature Manual	Federal	1 year 6/84	Esch
Hess Creek Frozen Slope Review	Federal	1 year 6/84	Reckard/R & M Consultants
Experimental Permafrost Study	Federal	1 year 6/84	Esch/Engineering Experiment Station
Predictions of Fines in Base	Federal	1 year 6/84	Brawner/Johnson
Pavement Temperature Analysis	Federal	1 year 6/84	McHattie
Investigation of Uncrushed Base	Federal	1 year 6/84	McHattie/Johnson
Effects of Salt on Embankments	Federal	1 year 6/84	Reckard/Institute of Water Resources, UAF
Performance Life of Overlays	Federal	1 year 6/84	Connor/Engineering Experiment Station
Thermal Performance of Heat Tubes	Federal	1 year 6/84	Brawner
Design Aid for Thermal Analysis	Federal	1 year 6/84	Connor/Engineering Experiment Station
Sludge for Highway Seeding	Federal	1 year 6/84	Kailing/Engineering Experiment Station
Corrosion of Modulus with Fines	Federal	4 months 9/84	Connor
Solar Assisted Culvert Thaw Devices	State	3 years 12/83	Brawner
Frost Heave Model Evaluation	Federal	2 years 2/85	Esch/Moses/Engineering Experiment Station, UAF/U.S. Army Cold Regions Research and Engineering Lab

FACILITIES RESEARCH PROGRAM

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
Remote Facilities Monitoring	State	5 years 6/85	Hegdal/Leonard/Rezek/Engineering Experiment Station
Meteor Burst Demonstration	State	6 years 12/86	Hegdal/Engineering Experiment Station
Solar Alaskan School	State	4 years 12/84	Rezek/Fairbanks North Star Borough
Vehicle Air Quality	State	6 years 6/86	Kailing/U.S. Army Cold Regions Research and Engineering Lab
Passive Solar Implementation	State	3 years 12/85	Rezek/Fairbanks North Star Borough/Strandberg Consultants
Moist Insulation Study	State	4 years 6/86	Rezek/Engineering Experiment Station
Department Communications	State	2 years 10/84	Rezek/Engineering Experiment Station
Refrigerated Foundation System	State	3 years 12/85	Hegdal/University of Alaska
Furnace Efficiency, Phase II	State	2 years 12/84	Kailing/Engineering Experiment Station
Building Air Quality	State	3 years 6/85	Kailing/Engineering Experiment Station/Geophysical Institute
Thermal Performance Standards Phase III	State	3 years 6/85	Leonard/Hegdal/Applied Research Associates/Engineering Experiment Station
Building Failures Study	State	2 years 12/84	Rezek/Fugelstad
Seismic Engineering Data	State	2 years 12/85	Rezek
Refrigerated Pad Design Procedure	State	2 years 6/85	Hegdal
Atmospheric Pollutant Transport Model	State	2 years 12/85	Kailing
Diesel-Electric P-L Fuel Economy	State	1 year 12/84	Leonard/Engineering Experiment Station

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
Freeze-Thaw Insulation Response	State	3 years 12/86	Rezek
Freezing Point Depression in Soil	State	3 years 12/86	Hegdal
Air Flow Window Performance	State	2 years 12/85	Rezek
Low Energy Sewage Disposal	State	3 years 6/86	Kailing
Ventilation Rate Model	State	2 years 6/85	Kailing
Caulking/Sealing Materials	State	3 years 6/86	Rezek
Anchorage Office Settlement Determination	State	2 years 12/85	Hegdal
Buildings and Energy Investigation	State	2 years 12/85	Leonard
Energy Conservation Studies	State	3 years 12/84	Leonard/Rezek/Kailing/Sunfair Engineering/Engineering Experiment Station, UAF
Roofing Material Investigation	State	4 years 6/85	Rezek
Utility Freeze Protection	State	4 years 12/85	Hegdal
Public Facility Building Codes	State	3 years 6/84	Kailing
Public Building Life Cycle Costing	State	3 years 6/84	Hegdal/Institute of Social and Economic Research
Passive Solar Alaskan School 2	Federal	4 years 12/84	Rezek/Institute of Water Resources
Special Projects	State	5 years 12/84	Leonard/U. S. Department of Energy
Fuel Cell Testing	State	3 years 6/83	Leonard/Engineering Experiment Station

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
Asphalt Aggregate Specifications	State	3 years 6/85	McHattie/Miller/Oregon State University
Corrosion Research, Phase II	State	3 years 12/83	Kailing/Miller/Peratrovich, Nottingham & Drage
Passive Refrigeration	State	2 years 12/84	Miller/Wade/Siebe/Shannon and Wilson
Radio Isotope Illuminators	State	1 year 12/83	Leonard/Miller/U. S. Department of Energy
Remote Airfield Stabilization	State	2 years 12/84	Miller/Esch/Battelle Memorial Institute
Rural Airport Edge Lighting	State	2 years 12/84	Miller/Leonard/U.S. Department of Energy
Loading of Float Connections	State	2 years 6/85	Miller/Rezek
Deterioration of Wood Piling	State	2 years 6/85	Rezek/Miller
Improved Cold Weather Concrete	State	2 years 6/85	Rezek/Miller/Shannon and Wilson
Atmospheric Corrosion Study	State	2 years 6/85	Miller/Kailing
Transportation System Research	State	3 years 12/86	Miller/Leonard/Shannon and Wilson
Automatic Weather Observing System	State	2 years 9/84	Miller/Hegdal/Federal Aviation Administration
Hydroplaning Prevention Research	State	3 years 12/84	Miller/Rezek
Transportation Research Project	State	3 years 6/84	Miller/Leonard
Noorvik Airport Lighting	State	3 years 12/83	Miller
Jetfoil Demonstration	State	2 years 6/84	Miller/Leonard

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
Breakwater Monitoring	State	1 year 12/83	Miller
Bridge Deck Repair Techniques	State	1 year 12/83	Miller
Earthquake Hazards	State	1 year 12/83	Miller/Geophysical Institute
Homer Spit Erosion Study	State	2 years 12/85	Miller
Icebreaker Research FY84	State	1 year 6/84	Miller/Sweet

NEW PRODUCTS TESTING AND SPECIAL PROJECTS

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
General Administration of Research	State	4 years 12/84	Sweet
New Products Testing	State	4 years 12/84	Sweet
Solar Room	State	12/85	Hegdal
Utilidor Freeze-up	State	12/85	Hegdal
Bird Creek Seismic Profile	State	6/84	Sweet
Erosion Control Products	State	2 years 12/84	Miller/Moses
Research Cataloging System	State	4 years 12/84	Sweet
Engineering Student Program	State	3 years 12/85	Sweet/Kailing/Connor/Esch/ Engineering Experiment Station
New Products/Special Projects	State	2 years 12/84	Sweet
Operational Testing of CMA	State	3 years 12/85	McHattie
PFT Air Exchange Test	State	2 years 6/84	Kailing
Seismic Investigation of Riprap Sources	State	2 years 12/85	McHattie/Weaver
Culvert Thawing Study	State	2 years 12/85	Connor
Reinforced Earth Slab at Auke Bay	State	2 years 12/85	Esch/Johnson
Airport Subsurface Evaluation	State	4 months 12/83	Miller/Johnson/U.S. Army Cold Regions Research and Engineering Lab
Waste Oil Heater Evaluation	State	1 year 12/84	Kailing

Project	Funding Agency	Duration/ Comp. Date	Project Manager/Consultant
Solar Culverts, Phase III	State	1 year 12/84	Sweet
Kennametal Grader Blades	State	1 month 12/83	Sweet/Guenther
Elfin Cove Paint Test	State	1 year 6/84	Sweet
Administration of Research	State	2 years 6/85	Sweet/Geophysical Institute
General Research Administration	State	3 years 12/84	Sweet/University of Alaska Computer Network
New Products Testing	State	3 years 12/84	Sweet/Geophysical Institute
Use of Screw Piles	State	3 years 12/84	Miller/Ross
Portable Soil Sampler	State	3 years 12/85	McHattie
Pavement Rating Using Electronic Imaging	State	2 years 6/84	McHattie
Montana Asphalt Pooled Fund Study	State	3 years 12/85	McHattie
Freeze/Thaw Tubes	State	2 years 12/84	Sweet/Geophysical Institute
Chem-Crete Asphalt Additive	State	9/83	McHattie
Paint Stripe Removal	State	12/83	Esch
Sand Confinement Grid Evaluation	State	12/83	Sweet/Engineering Experiment Station

SECTION 6
IMPLEMENTATION

The end product of research studies is the implementation of the final results into common practice. Implementation is a continual process involving publications, seminars, workshops, papers at technical meetings, work on committees, and public presentations. Listed below are some of those activities in which research personnel participated during the past fiscal year.

Implementation Seminar Series

The Research Program sponsored the following seminars during the past year:

Sand Grid Confinement Systems -- Department and Presto Products personnel; Fairbanks, August 24.

Designing with Geotextiles -- Dr. Robert Koerner, Drexel University, and Dr. Robert Bell, Oregon State University; Anchorage, September 12-14.

Battelle Research Institute Program -- Mr. Chuck Kim, Manager, Department of Transportation and Structures, Battelle Columbus Laboratory; Fairbanks, October 19.

Chemical Soil Stabilizers -- Mr. Don Coxon and Mr. Kameoka, Chiyoda International; Fairbanks, December 7.

Radioluminescent Airport Lighting -- Lee Leonard and Lorena Hegdal, Department Research Program; Fairbanks, January 16, 26, and 31.

Climatic Warming: Theory and Evidence -- Dr. Gunther Weller, Geophysical Institute, University of Alaska; Fairbanks, May 7.

Solar Permafrost Prethawing -- Dave Esch, Department Research Program; Fairbanks, May 7.

Illi-Pave, A Finite Element Pavement Analysis Program -- Marshall Thompson, University of Illinois; Fairbanks, June 28.

Open Graded Base Courses -- Marshall Thompson, University of Illinois; Fairbanks, June 29.

Other technology transfer and implementation workshops where presentations were made:

FHWA Research Managers Conference:
Benefits of Research -- Larry Sweet, Department Research Program; Berkeley, California, August 3.

U. S. Department of Energy Technology Transfer Conference:
Radioluminescent Airport Lights -- Lee Leonard, Department Research Program; Oak Ridge National Laboratory, Tennessee, March 22.

FHWA Technology Transfer Workshop:
Microcomputers in Transportation -- Larry Sweet, Department Research Program; Seattle, Washington, June 28.

Committee Participation

Transportation Research Board, National Academy of Sciences:
Pavement Management Systems Committee -- Dave Esch, Billy Connor
Flexible Pavement Design Committee -- Dave Esch
Data Acquisition and Analysis Committee -- Billy Connor
Frost Action Committee -- Dave Esch (Chairman)
Strength and Deformation of Highway Materials Committee -- Billy Connor
Highway Noise Committee -- Dave Esch

Department of Transportation and Public Facilities Statewide Committees:

Computer Users Group -- Billy Connor
Weigh-in-Motion Technical Users Group -- Billy Connor
Highway Improvement Systems Committee -- Billy Connor
Data Base Management Committee -- Billy Connor
Toxic and Hazardous Materials Committee -- Steve Kailing
Northern Region Safety Committee -- Steve Kailing
State Aviation Systems Plan Technical Advisory Committee -- Ron Miller
Joint State/Federal Coastal Data Management Committee -- Ron Miller
Nome Port Feasibility Committee -- Ron Miller
Professional Service Contracting Policy Committee -- Ron Miller

American Society of Civil Engineers Research Committee -- Larry Sweet

Fairbanks North Star Borough Committees:

Inspection and Maintenance Program Development Committee -- Lee Leonard
Air Quality Working Group -- Steve Kailing

National Building Thermal Envelope Coordinating Council -- John Rezek

Papers presented at Technical Conferences

University of Alaska Transportation Forum:

Radioluminescent Airport Lights -- Lee Leonard
Determination of Highway Load Restrictions -- Billy Connor

American Society of Civil Engineers Cold Regions Specialty Conference:

Building Air Exchange Problems -- Steve Kailing
Optimum Sand Specifications -- Billy Connor
Surface Modifications for Thawing Permafrost -- Dave Esch

Fourth International Conference on Permafrost:

Development of Air Duct Systems -- Billy Connor

Design and Performance of Road and Railway Embankments on Permafrost -- Dave Esch

Evaluation of Experimental Design Features for Road Construction Over Permafrost -- Dave Esch

Benefits of Peat Underlay in Highway Road Construction -- Robert McHattie

Field Trip Speakers -- Billy Connor, Dave Esch, Robert McHattie, Larry Sweet

Transportation Research Board:

Development of Thaw Tubes -- Billy Connor

University of Alaska Research Review Forum:

Department of Transportation and Public Facilities Research Programs -- Larry Sweet

Western Association of Transportation Officials:

The Falling Weight Deflectometer as a Maintenance Tool -- Billy Connor

Performance of Experimental Design Features Over Permafrost -- Dave Esch

Maintenance Benefits of Rubberized Asphalt -- Dave Esch

Winter Maintenance Benefits of Calcium Magnesium Acetate -- Robert McHattie

Illuminating Engineering Society of North America:

Radioluminescent Lighting for Rural Alaskan Airports -- Lee Leonard and George Jensen, Battelle Research Institute

Advisory Board Membership

University of Alaska Transportation Center -- Mim Dixon, Larry Sweet

U. S. Department of Energy Technical Working Group for Radioluminescent Airport Lighting Development -- Lee Leonard and Lorena Hegdal

Northwest Technology Transfer Center -- Larry Sweet

Fairbanks North Star Borough Community Research Center -- Larry Sweet

State of Alaska Climate Planning Advisory Group -- Larry Sweet

Public Presentations

University of Alaska Research Days Program:

Springtime Highway Load Restrictions/Highway Permafrost Problems -- Larry Sweet

Fairbanks Chamber of Commerce:

Calcium Magnesium Acetate: A Non-Corrosive Road Deicer -- Mim Dixon, Robert McHattie, Larry Sweet

Highway Condition Inventory with the Falling Weight Deflectometer -- Billy Connor

Radioluminescent Airport Lighting -- Lee Leonard, Lorena Hegdal

Decentralized Inspection and Maintenance Program -- Lee Leonard

Fairbanks Rotary Club:

Springtime Highway Load Restrictions -- Billy Connor

Fairbanks North Star Borough Air Quality Working Group:

Building Air Exchange Problems in Cold Regions -- Steve Kailing

Joint House/Senate Transportation Committee, Alaska State Legislature:

Status of Alaska Highways -- Dave Esch

Federal Aviation Administration:

Radioluminescent Airport Lighting -- Lee Leonard

Alaska Air Carriers Association:

Radioluminescent Airport Lighting -- Lee Leonard, Lorena Hegdal, Janet Strid

Civil Air Patrol:

Radioluminescent Airport Lighting -- Lee Leonard, Janet Strid

Flying Lions:

Radioluminescent Airport Lighting -- Lorena Hegdal, Larry Sweet

City of Central, Alaska, Public Meeting:

Radioluminescent Airport Lighting -- Lee Leonard, Lorena Hegdal

Fairbanks Regional Aircarriers:

Radioluminescent Airport Lighting -- Lee Leonard, Lorena Hegdal

American Society of Civil Engineers, Fairbanks Chapter:

Calcium Magnesium Acetate -- Robert McHattie

Radioluminescent Airport Lights -- Lee Leonard

Western Association of State Legislators:

Field Trip: Highway Construction Problems in Permafrost -- Larry Sweet

Technical Exchange Program

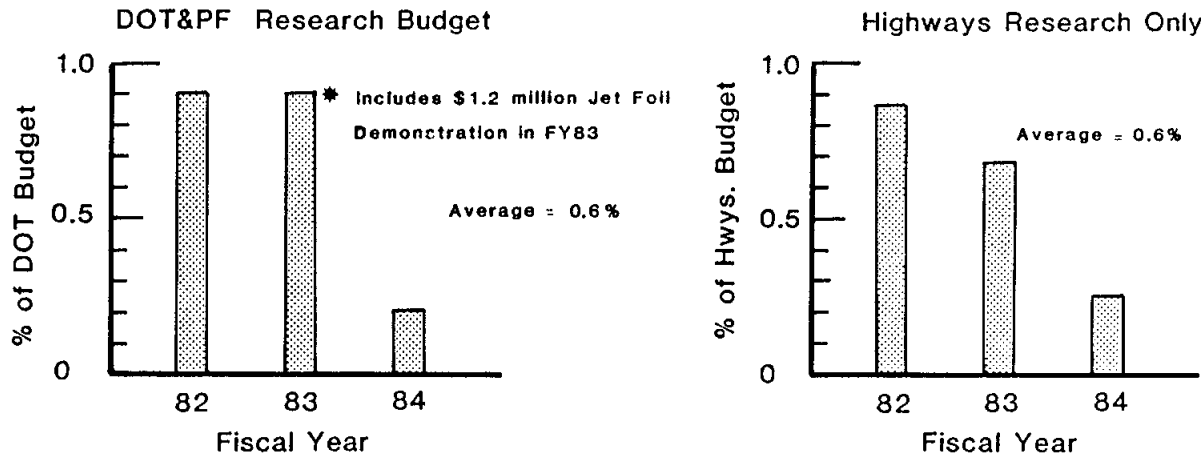
During the past fiscal year Mr. Martti Eerola, from the Road and Materials Section of the Technical Research Center of Finland, spent six weeks in residence with our highway research group. Mr. Eerola's visit was to compare the methods for design, construction, and maintenance of highway systems in Finland with our methods in Alaska.

SECTION 7
FUNDING AND EXPENDITURES

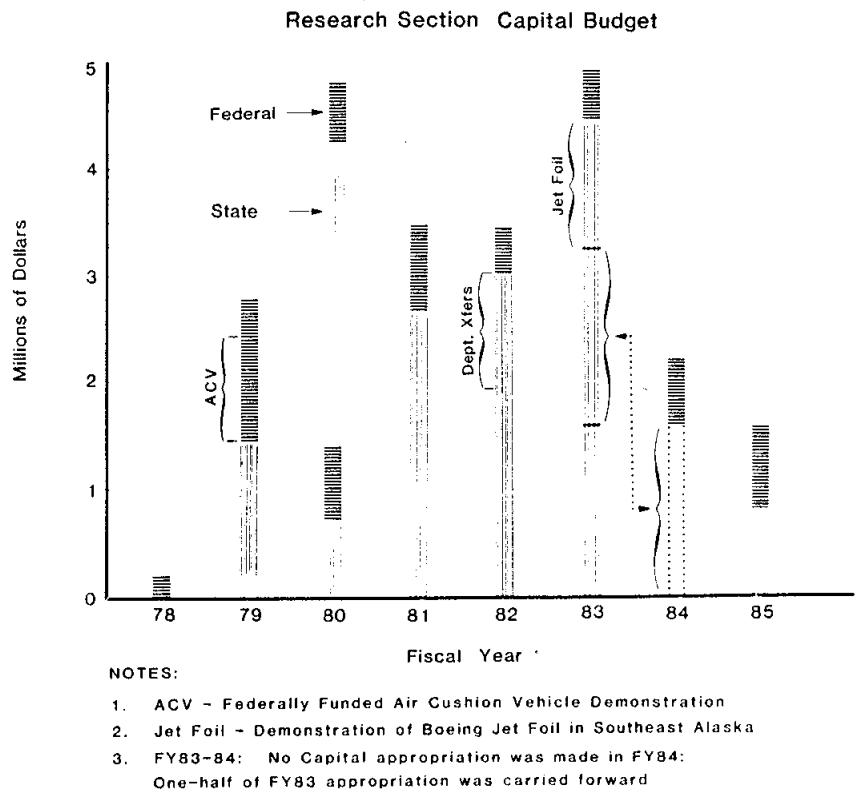
Funding History

The chart below illustrates the percentage of the total Department budget that has been committed to research for the past three fiscal years. This chart includes funding from all sources -- state, federal, and private -- in both the capital and operating budgets. The graphs on the following page detail the history of both the capital and operating budget for research.

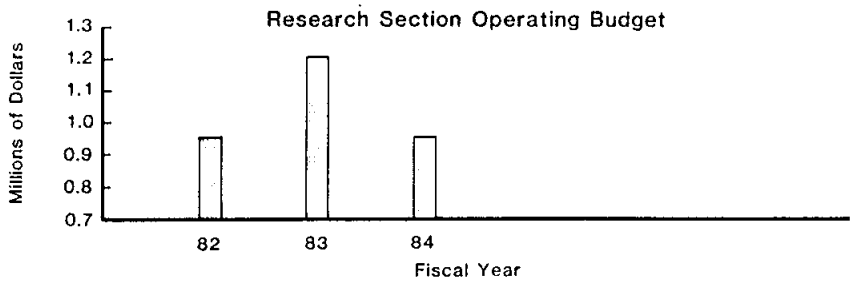
Research Funding



Both charts include funding from all sources - state, federal, and private, in both the capital and operating budgets.



The bar chart above summarizes the authorized capital budget funding history for the Research Program since the creation of the Department of Transportation and Public Facilities on July 1, 1977.



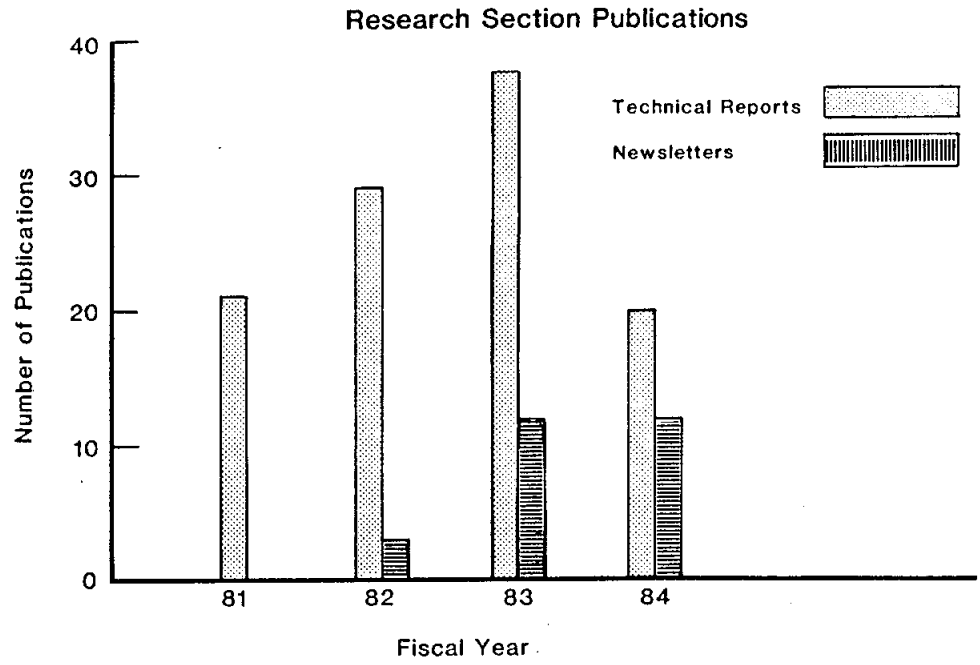
The diagram above details the General Fund operating budget for the Research Program for the last three fiscal years. The figures represent actual dollars appropriated with no adjustments for inflation.

SECTION 8
PUBLICATIONS

Listed on the following pages are the technical publications and research newsletters ("Research Notes") produced and distributed by the Research Program during FY 1984.

An asterisk indicates that copies of the reports are no longer available from the Research Program. These reports are in state libraries. Copies may be ordered through the Arctic Environmental Information and Data Center, University of Alaska, 707 A Street, Anchorage, Alaska, 99501, phone number (907) 279-4523.

A complete list of technical publications produced since July 1, 1980, may be obtained by writing to the Research Program, Department of Transportation and Public Facilities, 2301 Peger Road, Fairbanks, Alaska 99701.



FY84 Technical Reports

AK-RD-84-01 McHattie, R. L., D. C. Esch, J. P. Zarling, B. Connor, and C. J. Goering, Experimental Roadways on Permafrost, Interim Study Reports, 20 pp., July 1983.

AK-RD-84-02 Malosh, J. B., Fuel Cell Power Plants in Rural Alaska, 40 pp., April 1983.

AK-RD-84-03 McGlothlin Balivet Co., D. B. Olson, Raj Bhargava Associates, and HMS, Inc., Public Facility Building Codes, 69 pp., June 1983.

AK-RD-84-05 McHattie, R. L., Estimating the Durability of Chem-Crete Modified Paving Asphalt, 43 pp., August 1983.

FHWA-AK-RD-84-06 Atkins, R.T., In-Situ Thermal Conductivity Measurements, 41 pp., June 1983.

FHWA-AK-RD-84-07 Johnson, E.G., Application of Geotextiles in Alaska, 64 pp., August 1983.

AK-RD-84-08 Coetzee, Nicolaas F., Product Evaluation: Presto Roadbase Sand Confinement Grid, 25 pp., June 1983.

AK-RD-84-09 Coutts, H.J., Low Temperature Automotive Emissions and Inspection and Maintenance Effectiveness, Vol. 1, 36 pp., November 1983.

AK-RD-84-09 Coutts, H.J., Low Temperature Automotive Emissions and Inspection and Maintenance Effectiveness, Vol. 2, 164 pp., November 1983.

AK-RD-84-10 Zarling, John P., Billy Connor, Air Duct Systems for Roadway Stabilization Over Permafrost Areas, 55 pp., March 1984.

AK-RD-84-11 Brown, J., B.E. Brockett, K.E. Howe, Interaction of Gravel Fills, Surface Drainage, and Culverts with Permafrost Terrain, 41 pp., January 1984.

AK-RD-84-12 Durrenberger, J., Furnace Efficiency Testing, 37 pp., August 1983.

AK-RD-84-13 Johnson, J.B., Frost Jacking Forces on H and Pipe Piles Embedded in Fairbanks Silt, 80 pp., March 1984.

AK-RD-84-14 Peratrovich, Nottingham, and Drage, Inc., Costs to the Public Due to the Use of Corrosive Deicing Chemicals and A Comparison to Alternate Winter Road Maintenance Procedures, 33 pp., December 1983.

AK-RD-84-15 Johnson, R., Oil and Gas Fired Heat Generation Systems in Alaska, 1983.

AK-RD-84-16 Jensen, G., L. Perrigo, L. Leonard, and L. Hegdal, Examination of the Feasibility for Demonstration and Use of Radioluminescent Lights for Alaskan Remote Runway Lighting, January 1984.

AK-RD-84-17 Kailing, Stephen H., Air Exchange Rate Measurements Baseline Study of Seven Buildings in Fairbanks, AK, 36 pp., December 1983.

AK-RD-84-18 Reckard, Matthew K., Concrete Bridge Deck Corrosion in Alaska, 1984.

AK-RD-84-19 Coutts, H.J., Development of a Standard Driving Cycle for Fairbanks, Alaska, 1984.

AK-RD-84-20 Research Program, Summary of Research - FY84, June 1984.

RESEARCH NOTES
FY84

AIRPORT LIGHTING FOR RURAL ALASKA
July 1983, Volume 3, Number 1, Leroy E. Leonard.

PROGRESS IN ALASKAN PAVEMENT DESIGN
August 1983, Volume 3, Number 2, Robert L. McHattie.

AIR DUCT GROUND STABILIZATION SYSTEM
September 1983, Volume 3, Number 3, Billy Connor.

AUTOMATED WEATHER OBSERVING DEMONSTRATION AT GALENA
October 1983, Volume 3, Number 4, Ronald E. Miller.

GUARDED-HOT-BOX
November 1983, Volume 3, Number 5, John F. Rezek.

FROST HEAVE PREDICTION--LAKE HOOD TEST SITE
December 1983, Volume 3, Number 6, David C. Esch.

A THERMAL AND LIGHTING STANDARD FOR ALASKA
January 1984, Volume 3, Number 7, Leroy E. Leonard.

CMA--AN ALTERNATIVE ROAD DEICER, Summary and Continuation of Research
February 1984, Volume 3, Number 8, Robert L. McHattie.

HOT SAND FOR ICY ROADS
March 1984, Volume 3, Number 9, Matthew K. Reckard.

RADIOLUMINESCENT AIRPORT LIGHTING
April 1984, Volume 3, Number 10, Leroy E. Leonard.

TOTAL COST OF ROAD DEICING
May 1984, Volume 3, Number 11, Ronald E. Miller.

FURNACE EFFICIENCY TESTING
June 1984, Volume 3, Number 12, Stephen H. Kailing.

SECTION 9
ACKNOWLEDGEMENTS

During the past year the Research Program has received assistance and cooperation from many individuals within the Department, from state and federal agencies, and from companies in private industry. These contributions to the objectives of the Department are appreciated.

The activities of the Research Sections are guided by the Research Advisory Boards composed of the following members:

HIGHWAY RESEARCH ADVISORY BOARD

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Dan Malick, Director, Planning Division, Statewide
Mike Tooley, Project Manager, Design Branch, Central Region
Sandy Williams, Highways/Aviation Chief, Southeast Region
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Ron Tanner, Traffic/Safety Engineer, Northern Region
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Eric Johnson, Statewide Standards and Technical Services

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Don Kettner, Statewide Standards and Technical Services
George Diry, Naval Architect, Alaska Marine Highway System

Joe Camp, Deputy Commissioner, Marine Highway System (Ex-Officio)
H. "Glen" Glenzer, Deputy Commissioner, Northern Region (Ex-Officio)

The continued support and cooperation provided to us by the University Engineering Department and particularly Dr. Vincent Haneman, Dean of the School of Engineering, demonstrates the benefits obtained by the close working relationships between state agencies.

A special acknowledgement is extended to Mr. H. "Glen" Glenzer, Jr., Deputy Commissioner, Northern Region, for his efforts in helping implement the results of our research projects.